Chapter 6
Additional Improvement Opportunities

This chapter focuses on techniques which may be employed at lithographic print shops to prevent pollution, to reduce chemical consumption, and to minimize waste. Section 6.1 examines results from a pollution prevention survey, which asked lithographers to identify what activities they currently employ to achieve a more environmentally friendly workplace. The most common of these activities and their effects are presented. The pollution prevention benefits that result from changing workplace practices are discussed in detail. Section 6.2 addresses options for recycling solvents and the economic and environmental implications associated with such recycling. Methods for extracting solvents from press wipes are addressed, as are methods for treating spent solvents so that they may be reused. Solvent recycling and distillation systems are also discussed.

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6.1 POLLUTION PREVENTION OPPORTUNITIES

Pollution prevention, toxic chemicals reduction, and waste minimization efforts within a print shop can take many and varied forms. The "Workplace Practices Questionnaire for Lithographers" was used to collect information on many such efforts. This survey tool was developed by printers, union representatives, consultants to the printing industry, suppliers, and the University of Tennessee Center for Clean Products and Clean Technologies. The questionnaire was distributed in 1992 by representatives from the Printing Industries of America, the Graphic Communications International Union, the Association of Quick Printers, and printers who helped design the questionnaire. Two-hundred and six questionnaires were completed by printers, and comprise the database from which the following information was drawn. Improved workplace practices, facility programs (e.g., pollution prevention or waste minimization programs), as well as process, equipment, and product changes were the primary categories of pollution prevention opportunities identified in the questionnaire.

6.1.1 Summary of Responses to Workplace Practices Questionnaire

Of the respondents to the questionnaire, 76 percent have tried alternative blanket washing chemicals products, as shown in Table 6-1. This option was the most frequently tried pollution prevention option identified by the respondents to the questionnaire. Changes in workplace practices to prevent pollution were next at 48 percent. Nearly 30 percent of the respondents indicated they had implemented either equipment and/or process changes to improve the blanket washing process.

Table 6-1. Blanket Washing Activities to Prevent Pollution

Pollution Prevention Activity	% Response
Tried Alternative Blanket Wash	76.1%
Implemented Workplace Practices Changes	48.4%
Established Pollution Prevention, Waste Minimization, or Source Reduction Program	36.1%
Implemented Equipment Changes	28.8%
Implemented Process Changes	26.9%

Note: Due to multiple responses, numbers add to more than 100%.

Many printers are realizing that implementing changes such as these can save time and cut costs while preventing pollution. From the results of the Workplace Practices Questionnaire, over 70 percent of the respondents who have implemented changes to reduce the use of blanket wash indicated that materials cost had decreased or remained unchanged. Furthermore, the time required to clean the blanket for these respondents had either remained unchanged or decreased for 61 percent of the respondents. These results are presented in Table 6-2.

Table 6-2. Effects of Pollution Prevention Activities

Parameter	% Response			
	Increased?	Decreased?	No Change?	No Response
Materials Cost	24.6%	36.9%	33.8%	4.6%
Time to Clean Blanket	36.9%	32.3%	29.2%	1.5%
Waste Run After Cleaning	24.6%	21.5%	49.2%	4.6%

The application of alternative chemical products can significantly reduce chemical exposures in the workplace. Many alternative products contain a reduced percentage (< 30%) of volatile organic compounds (VOCs), or are derived from chemical sources other than petrochemical feedstocks. The questionnaire asked printers which alternative products they have implemented or tested; Table 6-3 summarizes the responses. These results show that the alternative products most frequently used were either citrus-based (nearly 53 percent) or low VOC-content (approximately 40 percent) products.

Table 6-3. Alternative Blanket Washing Products Implemented or Tested by Printers

Product Category	% Response
< 30% VOC Content	39.2%
Citrus-Based	52.9%
Oil-Based	10.5%
Surfactant-Based	11.8%

Note: Due to multiple responses, numbers add to more than 100%.

Further investigation into the application of alternative products identified over 50 percent of the respondents were satisfied with the performance of the alternative chemical products, independent of the type of alternative chemical products tried. Forty-four percent found alternative products unsatisfactory. Inadequate product information and operator preference were the two primary reasons identified by those respondents who had not tried alternative chemical products. The evaluation of alternative blanket washing chemical products is the focus of this CTSA; further discussion of pollution prevention opportunities in this section will therefore focus on workplace practices and facility programs to prevent pollution.

6.1.2 Workplace Practices

As the second pollution prevention effort most frequently identified by the respondents of the questionnaire, improved workplace practices can encompass every sector of a print shop. Even when focusing strictly on the blanket washing, workplace practices have the potential to eliminate or minimize sources of pollution and reduce chemical exposure to workers and the public. The Workplace Practices Questionnaire compiled data on many workplace activities. The following discussions summarize common workplace practices to prevent pollution and draw upon the results of the questionnaire for practical examples.

Raising Employee Awareness

Raising employee awareness of pollution prevention benefits is the best way to get employees to actively participate in pollution prevention efforts. Many press operators are reluctant to change from traditional blanket washing chemicals and methods; they simply do not believe the alternative, less polluting chemical products and methods will work. This unwillingness to try new products and new technologies may imply that printers are unaware of the potential benefits. Printers need to understand that pollution prevention can result in improved worker health and safety, an improved working environment, cost savings, and reduced or less toxic waste streams, which means less overall impact on human health and the environment. One printer indicated that his new operators are more conscientious and use less blanket wash; this may illustrate benefits gained from raising employee awareness of the health, safety and environmental issues associated with workplace practices.

Furthermore, many printers are beginning to design and implement programs to teach employees about the benefits of pollution prevention. Thirty-six percent of the respondents to the questionnaire report having a pollution prevention, waste minimization, or source reduction program at their facility. One printer in Kansas City, Missouri is required to prepare a written pollution prevention program as a large quantity hazardous waste generator. He goes on to explain, however, that this program is only the basis of a big-picture, source reduction program implemented at the facility. Similarly, a printer in Kent, Washington, and others, stated they have

adopted the corporate pollution prevention and/or waste management program as their facility program. Other printers contacted indicated that their pollution prevention programs were management strategies, rather than written programs.

Table 6-4 lists steps designed to raise employee awareness, including written environmental policies, and the benefits of these activities. Other examples drawn from the questionnaire include a shop owner in Harrisburg, Pennsylvania, who organizes monthly meetings with his print operators to inform them of new products, to review Material Safety Data Sheets, and update printers on the newest waste management strategies. Periodic training is also offered to maintain optimal printing techniques and effective waste minimization/management practices. At another facility in Madison, Wisconsin, printers have commented on the improved working conditions resulting from the implementation of a low-VOC blanket washing product. The headaches and odors associated with the old products have been eliminated with the new product.

Materials Management and Inventory

Materials management and inventory control means understanding how chemicals and materials flow through a facility to identify the best opportunities for pollution prevention. Proper materials management and inventory control is a simple, cost-effective approach to prevent pollution. Keeping track of chemical usage and limiting the amount of chemicals on the process floor gives operators an incentive to use the minimum amount of chemical required to do the job. This was one benefit identified by a printer who now purchases non-bulk chemical products; this materials management practice resulted in a controlled use of chemicals on the press room floor. Ensuring that all chemical containers are kept closed when not in use minimizes the amount of chemical lost through evaporation to the atmosphere. Not only do these simple practices result in less overall chemical usage, thus representing a cost savings, they also result in reduced worker exposure to chemicals and an improved working environment. Table 6-5 lists some of the steps to and benefits of materials management and inventory control.

Selected results from the Workplace Practices Questionnaire reveal that many printers follow a number of these materials management and inventory practices. In one portion of the questionnaire printers were asked to describe their chemical storage practices (how and where), as well as the way(s) in which these products are retrieved for use at a press. The largest percentage of printers, nearly 46 percent, store their chemical products in closed containers or safety cans. Over 35 percent of the respondents use closed drums or pails; safety cans, employed by 10 percent of the responding printers, can further improve the safety and working conditions of the print shop by offering a more improved form of chemical containment. Furthermore, over 50 percent of the printers responding to this portion of the questionnaire pump chemical products from large storage containers to the smaller containers used at the press.

These results also indicate that many printers have opportunities for improving their materials management practices to prevent pollution. Printers who are storing chemicals in open containers can easily improve worker conditions and prevent materials loss by simply using a closed safety container. Investing in a simple hand-held pump can have a rapid pay-back period due to the money saved from preventing the spills that can occur when chemicals are transferred from container to container by hand.

Table 6-4. Benefits of Raising Employee Awareness

Activity to Raise Employee Awareness	Benefits
Prepare a written environmental policy	Establishes environmental management goals; illustrates management commitment to pollution prevention and environmental goals
Prepare written procedures on equipment operation and maintenance, materials handling, and disposal	Better informs employees of the proper procedures for using equipment and disposing of materials; helps prevent accidents
Provide employee training on health and safety issues, materials handling and disposal	Ensures that employees have proper training to understand benefits of proper materials handling and disposal, and potential consequences of improper workplace practices to their health and safety, the environment, and company profitability
Seek employee input on pollution prevention activities	Encourages the persons closest to the process to develop the best, most creative approach to pollution prevention; employee involvement and ownership of the program has been essential to many successful programs
Make employees accountable for waste generation and provide incentives for reduction	Encourages employees to be aware of ways they can prevent pollution; rewards active involvement in pollution prevention activities
Provide feedback to employees on materials handling and disposal, and pollution prevention performance	Re-emphasized management commitment to pollution prevention; encourages employees to continue to improve

Table 6-5. Materials Management and Inventory Practices and Their Benefits

Workplace Practices	Benefits
Manage inventory on a first-in, first-out basis	Reduces materials and disposal costs of expired materials
Minimize the amount of chemicals kept on the process floor at any time	Gives employees an incentive to use less materials
Centralize responsibility for storing and distributing chemicals	Gives employees an incentive to use less materials
Store chemical products in closed, clearly marked containers	Reduces materials loss; increases worker safety; reduces worker exposure; prevents mixing of hazardous and nonhazardous materials
Use a pump to transfer chemical products from large containers to smaller containers that are used at work stations	Reduces potential for accidental spills; reduces worker exposure

Process Improvements

Once the flow of materials within a facility has been documented, the next step is to analyze the process to identify workplace practices that can be adopted to prevent pollution at the source. Process improvements through workplace practices mean reevaluating the day-to-day operation that make up the printing process. Table 6-6 lists some workplace practices, and their benefits, that prevent pollution.

The Workplace Practices Questionnaire also collected specific information on whether printers are using many of these process improvements. According to the results, 62 percent of the surveyed printers use squirt bottles to store chemical blanket washes at the press. In addition, 81 percent of the printers use safety cans, closed containers, and/or safety cabinets for chemical storage beside the press. The use of these materials minimize evaporative losses of chemical products and therefore prevents pollution. Very few respondents (less than 4 percent) identified the use of open containers of any kind beside the press.

In addition to chemical storage practices, many printers reported using good operating procedures to reduce worker exposure to blanket washing chemicals. The use of gloves (nearly 70 percent), eye protection, and aprons protects workers from direct contact with chemical products. The forty-four respondents (22.4 percent) who use no personal protective equipment, however, identify the great potential that exists in a print shop for chemical exposure reduction efforts.

Table 6-6. Process Improvements and Their Benefits

Workplace Practices	Benefits
Use plunger cans or squeeze bottles to deliver controlled quantities of blanket wash	Reduces potential for accidental spills; reduces materials use; reduces worker exposure
Apply a specified amount of chemical products to shop towels rather than an uncontrolled amount directly to blanket	Reduces chemical usage through controlled applications
Reduce the size of the towel or wipe used during clean-up, and use reusable towels or wipes	More efficient use of towels; reduces solvent use; reduces worker exposure
Use reusable towels or wipes, and reuse shop towels for multiple blanket washes	Reduces materials use (shop towels and blanket wash); reduces solid waste generation; reduces worker exposure
Store chemical-laden wipes in closed container between uses	Reduces chemical losses due to evaporation; reduces worker exposure
Evaluate alternative chemicals: water dilution ratios (increase the amount of water)	Reduces chemical usage with no loss of efficiency; reduces worker exposure
Only apply chemicals where necessary	Reduces chemical usage; reduces worker exposure
Avoid delays in cleaning blankets	Simplifies ink removal from blanket
Use appropriate personal protective equipment (gloves, eye protection, etc.)	Reduces worker exposure

The application of cleaning products to shop towels by squirt bottle or safety plunger, identified as standard practice by over 50 percent of the surveyed printers, is another workplace practice that controls the use of chemicals resulting in materials conservation and improved working conditions.

Discussions with printers identified further effective operating procedures and process improvements to minimize waste. One such operating procedure is limiting the number of times the blanket is washed. One respondent to the questionnaire cleans the blanket "only when finished, not every time the position of the plate is changed during a print run". A printer in Tucson, Arizona has changed workplace practices to optimize the number of wipes used. With this current workplace practice, which involves the use of an alternative wash supplemented by the limited use of a strong solvent, wipe use has been reduced by half.

Waste Management Practices

After the blanket is clean, there still exist opportunities for improving the management of waste products generated during normal printing operations. Table 6-7 presents basic workplace practices that can be applied to prevent pollution in the management of wastes. Tables 6-8 and 6-9 present information about printers waste management practices compiled from the Workplace Practices Questionnaire.

The results from the Workplace Practices Questionnaire presented in Table 6-8. After accounting for those printers for which storage of blanket wash chemicals is not applicable (49.8%), over three-fourths of the remaining printers store their blanket wash chemicals in closed containers. The methods of treatment and disposal presented in Table 6-8 reveal that there are a variety of management possibilities available to printers. Recycling of spent-solvents, whether on- or off-site, is preferable to discharging to a sewer system or disposing of the solvent as hazardous or non-hazardous waste.

Table 6-7. Waste Management Workplace Practices and Benefits

Waste Management Practices	Benefits
Maintain accurate logs of chemical and materials stock, chemicals and materials use, and waste generation rates	Understanding materials flow and how it relates to waste generation rates provides insights into pollution prevention opportunities
Segregate waste by waste stream and keep in marked, easily accessible, closed containers	Allows for more effective reuse and recycling of waste materials; prevents nonhazardous waste from becoming contaminated with hazardous waste; minimizes evaporation of chemical waste products; reduces worker exposure
Use gravity-drain, wringing, or centrifugation to collect excess chemical products from used shop towels and wipes	Recovers chemical products for reuse and recycling
Keep used shop towels and collect waste chemicals in closed containers	Minimizes evaporation of chemical waste products; reduces worker exposure

Table 6-8. Waste Management Practices for Waste Blanket Wash

Method of Storage	% Response	Method of Treatment/Disposal	% Response
In a closed container	39.9%	Sent to Recycler	14.8%
In an open container	3.4%	Recycled on-site	1.0%
No specific container	1.5%	Discharged to sewer	2.5%
Other	0.5%	Hazardous Waste	9.9%
No response	4.9%	Nonhazardous Waste	8.4%
Not applicable	49.8%	Other	4.4%
		No Response	9.4%
		Not Applicable	49.8%

Note: Printers were able to specify unique methods under the category "Other". The "Not Applicable" category represents those printers who indicated they do not generate and/or collect liquid waste blanket wash.

Table 6-9 identifies a variety of strategies available for the management of shop towels. As stated in Table 6-6, the use of reusable towels can be an effective pollution prevention practice which conserves natural resources and minimizes waste disposal fees. The cleaning of these reusable towels, however, creates a waste stream from the cleaning facility which must be considered. Collecting used towels in a closed container, a workplace practice employed by nearly 75 percent of the respondents, minimizes chemical losses via evaporation thus improving the work environment. When collected, a pretreatment method (e.g., centrifugation or wringing) to collect any excess chemical remaining on the towels is possible. One respondent to the questionnaire recovers spent blanket wash and reuses it to clean the press rollers. From the results of the survey, however, few printers (less than 10 percent) are taking advantage of such management strategies.

6.1.3 Conclusions

Several pollution prevention opportunities exist to reduce the quantity and toxicity of blanket washing materials used within lithographic printing facilities. Many of these opportunities can be accomplished simply by implementing various improved workplace practices. Written pollution prevention or waste minimization programs, proper materials management, process improvements, and waste management practices represent such workplace practices. A pollution prevention program can establish accepted operating procedures and set waste reduction goals. Proper materials management may offer incentives for printers to use less chemicals and minimize chemical losses through evaporation or inefficient use. It also provides a means to track improvements as well as the resulting cost savings. Safety and health benefits can be achieved with process improvements and proper waste management practices, as well as more efficient use of chemical supplies. These improved workplace practices can be achieved at little to no expense to the print shop; they are cost effective and represent good business practice.

Table 6-9. Waste Management Practices for Reusable Shop Towels

Method of Storage		Method of Pretreatment		Method of Reuse or Disposal	
In a closed container	74.4%	Centrifuge	3.4%	On-site Laundry	0.5%
In an open container	14.3%	Dryer	1.5%	Off-site Laundry	62.6%
No specific container	7.9%	Hand Wringing	3.9%	Hazardous Waste	4.9%
Other	3.4%	Automatic Wringer	0.5%	Nonhazardous Waste	11.3%
		None	70.0%	Other	16.8%
		Other	4.9%	No Response	3.9%
		No Response	15.8%		

Note: Printers were able to specify unique methods under the category "Other".

6.2 RECYCLE OPPORTUNITIES

There are several technologies that may make solvent recovery a viable alternative for printers seeking to reduce their operating costs and waste management expenses. Printers typically use cloth shop towels or leased towels to clean presses and blanket rollers. The spent solvents contained in these wipes may present toxicity and flammability concerns for printers, industrial laundries, and local sewer systems. Printers have adopted several practices for reducing the quantity and toxicity of the solvents left in their press wipes, including the extraction of solvent using a hand-operated wringer or explosion-proof centrifuge. Once extracted, solvents can then be directly reused for imprecise cleaning such as parts washing or can be treated by some form of distillation or filtration for reuse as a blanket cleaner. This section discusses options for extracting solvents from press wipes, as well as options for treating solvents for reuse. Solvent recycling systems used in conjunction with brush-based automatic blanket wash systems are also discussed below.

6.2.1 Solvent Recovery from Press Wipes

Solvent laden press wipes present several environmental concerns for printing facilities, industrial laundries, and local sewer systems that receive the laundry's wastewater. Concerns include volatility, flammability and aquatic toxicity of the effluent discharged by industrial laundries to publicly owned treatment works (POTW). Additionally, some states require that solvent laden press wipes be treated as a hazardous waste. EPA's mixture rule states that a non-hazardous product is rendered hazardous when combined with a hazardous material.[a] Most press wipes would, therefore, be classified as a hazardous waste once contaminated with a hazardous blanket cleaner. Many states, however, have recognized a conditional exemption from the mixture rule for contaminated press wipes. For example, Massachusetts does not consider industrial wipes

[a] *The mixture rule was struck down by a 1991 D.C. Circuit court ruling, but has been temporarily reenacted while EPA conducts a review of the rule. For an update of changes to RCRA, contact the RCRA Hotline at (800)424-9346.*

to be hazardous if they satisfy the following conditions: 1) the wipes are not saturated and are able to pass the Department of Environmental Protection's "one drop test"; and 2) wipes are handled in accordance with state and federal (OSHA) regulations requiring that used wipes be stored in closed containers designed for solvent laden contents. Massachusetts regulations forbid the air-drying of press wipes in order to satisfy the "one drip rule"; however, printers are permitted to extract solvents by hand wringing or mechanical compaction. Several other states recognize an exemption from the mixture rule for contaminated press wipes and industrial wipes in general.[1]

One approach to reducing the quantity and toxicity of solvent being shipped off-site in press wipes is to extract solvents from wipes for reuse or appropriate disposal.[2] This approach has the added benefit of potentially lowering overall solvent costs when solvents are recovered and reused. The following paragraphs discuss two options for extracting solvents from press wipes: hand-operated wringer and explosion-proof centrifuge. The use of these extraction devices may be regulated. Printers should consult with their state and local regulatory authorities before installing such equipment.

Extraction of Solvents from Press Wipes

Two basic methods are available for extracting solvents from press wipes: 1) hand-operated wringers and 2) explosion-proof centrifuges. Hand-operated wringers require the smallest capital investment and may prove to be a viable option for small printing operations that use a limited number of press wipes. When using a hand-operated wringer, printers should verify that the squeeze rollers are resistant to solvents and will not rapidly deteriorate. Squeeze rollers should be made of a rubber material, similar to that used on the blanket cylinder of an off-set printing press. One company manufactures a hand-operated wringer that mounts on the top of a 55-gallon drum. The squeeze rollers are made of nitrite and are resistant to several types of solvents, although printers should investigate the units' compatibility with their specific solvents and determine if any flammability concerns exist as a result of placing their solvents under pressure. The price of the unit is under $600.[3]

A second alternative for solvent recovery is an explosion-proof centrifuge which may be used for extracting cleaning solvents from used press wipes. The centrifuge is most appropriate for large printing facilities that generate significant quantities of shop towels.[b] These centrifuges are manufactured with a self-balancing, perforated basket that retains the rags while liquid solvents are squeezed out and drain through the outer containment shell. Solvents can be extracted from cloth shop towels or disposable wipes. It is estimated that a four-minute cycle can extract between 2.5 and 3.5 gallons of solvent for every load of 225 wipes processed. Centrifuges are available that can process 35, 60, 100, or 130 pounds per load and that cost between $21,000 and $30,000 depending upon the capacity required. The most popular model among printers processes 225 towels per load and costs roughly $25,000. Installation involves bolting the unit in place and connecting it to an appropriate power source and 60 pounds of air supply.[4]

Purchase of a centrifuge unit involves a substantial capital investment and may not be appropriate for all printers. Alternatively, printers may have the option of contracting with a mobile centrifuge service to extract solvents on-site. One such solvent extraction service in Minnesota, operates a van that transports an explosion-proof centrifuge to printing facilities for on-site solvent extraction. Once the solvents have been extracted from the shop towels, it is left to the printing facility to determine how to handle the solvent. Pricing for extraction services are based upon a rate of $65/hour, during which time it is possible to process between 1,500-1,800 towels.

[b] *Printers should consult with their local regulatory agency to determine if any restrictions exist for operating a centrifuge within their facility. For example, California and Virginia consider the operation of an on-site centrifuge to be a form of hazardous waste treatment and, therefore, subject to local permitting requirements. For a listing of all state environmental agency contacts, refer to the March 1995 issue of Graphic Arts Monthly.*

6.2.2 Methods of Solvent Recycling

Blanket wash solvent recovered from press wipes can not be immediately reused as a replacement for virgin solvents. Typically, solvents are separated by ink color, allowing solid particles to settle out before reuse. This process does not produce virgin quality solvent and is therefore best reused for imprecise cleaning, such as parts washing. Alternatively, used blanket wash can be treated by some form of distillation or filtration before reuse. The most common method of solvent recovery is distillation for both on-site and off-site applications.

Distillation of Blanket Wash

As an option for blanket wash recovery, the distillation process produces near virgin quality blanket wash. Most commercially available distillation units employ the differential distillation process. In this process, the liquid solution is heated to roughly 20 to 30 degrees above the desired solvent's boiling point, causing the more volatile (higher vapor pressure) components to vaporize. The relative boiling points of the solution components are critical for the effective operation of a distillation system. Solvent vapors rise into the condenser where they are cooled and recovered for reuse. Contaminants remain in the distillation tank and are disposed of as a liquid, semi-liquid or solid sludge. Waste residues, referred to as still bottoms, may be designated as hazardous waste if the they were distilled from a listed waste solvent (F-listed wastes). The recovery rate for a distillation unit averages roughly 90 percent.

One manufacturer can provide solvent distillation units with the capacity to handle between eight and 55 gallons of solvent. The largest unit provides the ability to process waste solvents in 20-gallon batches or 55-gallon units of continuous, closed-loop operation. The approximate cost of a 20-gallon unit is $12,000 and increases to $15,000 for the continuous feed option. For printers generating smaller quantities of solvents, a smaller model is available that handles 8-gallons of solvent per batch. The cost of an 8-gallon unit is approximately $3,300.[5] When considering the purchase of a distillation unit, printers should consider the quantities and type of solvent they hope to distill, as well as evaluate capital costs and operating costs for labor, electricity, and parts. Equipment vendors will run tests on a sample of spent solvent to determine whether the system will distill the solvent, and assess the recovery efficiency of the unit. One company charges $100 to test 5-10 gallons of used solvent.[6] In addition, some vendors may have units available for use on a trial basis, allowing printers to better assess whether a distillation unit is appropriate for their individual situation.

Safety concerns, however, are a significant consideration for printers contemplating the purchase of a distillation unit. For example, nitrocellulose, found in inks and paints, is an explosive when dry. Distillation of materials containing nitrocellulose is, therefore, not recommended. The International Fire Code Institute, an organization consisting of state fire marshals, has been investigating whether on-site distillation units constitute an explosion hazard given the flammable nature of the solvents they treat. Changes in the Uniform Fire Code are currently under consideration which may affect the availability of such units. Printers should consult with their local environmental regulatory agency and investigate whether any changes have been made in the Uniform Fire Code before investing in a distillation system.

In many cases on-site distillation will not be cost-effective for printers; instead, a commercial solvent recycling service may prove to be a better alternative. Three basic arrangements are available for off-site, solvent recycling: 1) toll recycling; 2) speculative recycling; and 3) waste brokers. Toll recycling involves off-site processing of solvents by a recycling firm for reuse by the printing facility. Typically large batches are required for such an approach to be cost-effective, although some recyclers will accept small quantities from many producers and combine their waste for batch distillation. Speculative recycling schemes recycle the waste solvents and then sell the product on the market. In this case, recyclers may pay the facility for solvents if the product has a high market value. Waste brokers match the needs the facility seeking to dispose

of their solvents with a potential waste user. Such an arrangement can only be considered a recycling scheme if the solvent is bought by a solvent recycler. More commonly, waste brokers will sell the solvent for use as a waste-derived fuel for use in a cement kiln or industrial furnace.[7]

Ultrafiltration of Blanket Wash

Several filtration technologies are available to handle a variety of applications requiring the removal of suspended waste particles from contaminated solutions. The ultrafiltration process operates by passing effluent through a porous material, screening out the largest molecules as the effluent travels through the filter. Through the use of selective pore sizing, solutions can be filtered to varying degrees of quality. Generally, filtration technologies are similar in that the membrane material is made of some type of proprietary polymer-blend. Where the technologies differ is in the substrate material that holds the membrane in its rigid form. Possible substrate materials include ceramics, stainless steel, and nylon.

According to industry sources, filtration technology is not being used in the lithographic printing industry apart from its use in the treatment of fountain solutions and in conjunction with automatic blanket cleaners. The primary barrier for the use of filtration technology is the incompatibility of the membrane materials with the solvents. One company, however, is currently testing a poly-vinyl, spiral wound membrane that is resistant to solvents and, therefore, appropriate for the treatment of many blanket cleaners.[8] The system will operate using cross-flow filtration. Effluent is passed under pressure across a spiral wound membrane. Gaps between the membrane create turbulence in the flow of the effluent, reducing top loading or clogging of molecules by knocking them off of the membrane's surface. The system is currently being tested and is said to have several advantages over ceramic and stainless steel technologies. The spiral membrane is capable of nanofiltration and is expected to be less costly than stainless steel systems.[9]

Conclusions

Solvent recovery from used shop towels may be an economically sound and environmentally improved alternative for printers. The extraction of spent solvent from shop towels, whether via hand-operated wringers or the use of explosion-proof centrifuges has permits the recovered solvent to be reused. For small printers with limited capital, hand-wringers are the least costly option, whereas larger printers with a greater number of towels to be processed may prefer explosion-proof centrifuges. Extraction of the solvent also provides benefits to printers in terms of reduced expenditures for virgin solvent and/or the use of the spent solvent for less precise equipment cleaning. When the recycled blanket wash solvent is to be reused in place of virgin solvent, distillation is the most common method of reclamation, whether conducted on-site by the printer, or off-site by commercial solvent recycling services. Ultrafiltration, although used in some lithographic processes, is not, as yet, a viable method for solvent reclamation.

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